[0318] What is claimed is:

1   1. A computer-implemented method of discovering relationships between

2   items, comprising:

3   accepting item selections from a plurality of users;

4   generating a log for each user, each log containing identifiers for the user's

5   item selections;

6   accepting a query including at least one query item identifier;

7   scoring the user logs, responsive to a degree of occurrence of the at least

8   one query item identifier in the user logs, to generate user log

9   scores; and

10   determining at least one result item, responsive to a degree of occurrence

11   in at least a subset of the scored user logs.

1   2. The computer-implemented method of claim 1, wherein a significance

2   of the occurrence is determined by a log likelihood ratio analysis and the deter-

3   mined result is responsive to the determined significance.

1   3. The computer-implemented method of claim 1, wherein a significance

2   of the occurrence is determined by a substantial equivalent of a log likelihood

3   ratio analysis and the determined result is responsive to the determined signifi-

4   cance.

1   4. The computer-implemented method of claim 1, wherein each item is a

2   video track and wherein accepting item selections comprises determining which

3   tracks are selected for playback.

1   5. The computer-implemented method of claim 1, wherein each item is a

2   music track and wherein accepting item selections comprises determining which

3   tracks are selected for playback.

1   6. The computer-implemented method of claim 5, further comprising:

2   generating a track list containing an identifier for each determined result

3   item comprising a music track.

1   7. The computer-implemented method of claim 6, further comprising:

2   deleting from the track list at least one identifier corresponding to a music

3   track already selected by the user.

1   8. The computer-implemented method of claim 6, further comprising:

2   playing the music tracks specified by the generated track list.

1   9. The computer-implemented method of claim 5, further comprising:

2   accepting a format schedule specifying music track categories for time pe-

3   riods; and

4   generating a track list conforming to the format schedule and containing

5   an identifier for each determined result item comprising a music

6   track.

1   10. The computer-implemented method of claim 5, wherein scoring the

2 user logs comprises determining a degree of occurrence in each user log of at

3 least one music track identified by the query item identifier.

1   11. The computer-implemented method of claim 5, wherein scoring the

2 user logs comprises determining a degree of occurrence in each user log of at

3 least one music track associated with an artist identified by the query item identi-

4 fier.

1   12. The computer-implemented method of claim 1, wherein accepting item

2 selections comprises receiving input provided by a user via a web page.

1   13. The computer-implemented method of claim 1, wherein accepting item

2 selections comprises receiving input specifying an item purchase by a user.

1   14. The computer-implemented method of claim 1, further comprising,

2 prior to determining the at least one result item, defining the subset of the scored

3 user logs responsive to the user log scores.

1   15. The computer-implemented method of claim 1, further comprising:

2   monitoring user behavior with respect to the selected items; and

3   adjusting the user log responsive to the monitored user behavior.

1   16. The computer-implemented method of claim 15, wherein monitoring

2   user behavior comprises at least one selected from the group consisting of:

3   detecting user input requesting that a selected item be repeated;

4   detecting user input requesting that a selected item be skipped;

5   detecting user input specifying a volume change; and

6   detecting user input specifying that a selected item be muted.

1   17. The computer-implemented method of claim 1, wherein accepting item

2   selections comprises receiving input provided by a user via an application for

3   playing tracks.

1   18. The computer-implemented method of claim 1, wherein accepting a

2   query comprises receiving a user log containing identifiers for a user's item selec-

3   tions.

1   19. The computer-implemented method of claim 1, wherein accepting a

2   query comprises receiving a first search term, the method further comprising:

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3   generating a second search term containing an identifier for each deter-

4   mined result item.

1   20. The computer-implemented method of claim 19, further comprising at

2 least one of:

3   providing the second search term as input for a search engine; and

4   adding the second search term to a searchable portion of a document as-

5   sociated with the first search term.

1   21. The computer-implemented method of claim 1, further comprising:

2   periodically uploading the generated log.

1   22. The computer-implemented method of claim 1, further comprising:

2   outputting an advertisement relating to the determined at least one result

3   item.

1   23. The computer-implemented method of claim 22, wherein outputting

2 an advertisement comprises displaying at least one selected from the group con-

3 sisting of:

4   a web page;

5   a banner;

6   a portion of a web page; and

7   an animation.

1   24. The computer-implemented method of claim 1, further comprising:

2   outputting a notification relating to the determined at least one result

3   item.

1   25. The computer-implemented method of claim 24, wherein outputting a

2   notification comprises displaying a web page.

1   26. The computer-implemented method of claim 24, wherein outputting a

2   notification comprises sending a communication to a user.

1   27. The computer-implemented method of claim 26, wherein sending a

2   communication to a user comprises at least one selected from the group consist-

3   ing of:

4   transmitting an electronic mail message to the user;

5   telephoning the user; and

6   sending a direct mail item to the user.

1   28. The computer-implemented method of claim 1, wherein the deter-

2   mined result is responsive to a significance of the occurrence of the item in at

3   least a subset of the scored user logs, and wherein the significance is determined

4   by a log likelihood ratio analysis submethod comprising:

5   determining a total number of user logs N;

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6   determining a number of user logs N_1 in a subset of user logs;

7   determining a number of user logs N_2 not in the subset of user logs;

8   determining a number of user logs k_{11} in the subset that include the item;

9   determining a number of user logs k_{12} not in the subset that include the

10   item;

11   determining a number of user logs $k_{21} = N_1 - k_{11}$ in the subset that do not

12   include the item;

13   determining a number of user logs $k_{22} = N_2 - k_{12}$ not in the subset that do

14   not include the item;

15   and determining a log likelihood ratio for the item.

1   29. The computer-implemented method of claim 28, wherein the log like-

2   lihood ratio is defined as:

3
$$\sum k_{ij} \log \frac{\pi_{ij}}{\mu_j}$$

4   where: $\pi_{ij} = \frac{k_{ij}}{N_j}, \mu_j = \sum_i \frac{k_{ij}}{N}.$

1   30. The computer-implemented method of claim 29, further comprising:

2   adjusting at least one of the k_{ij} values responsive to at least one selected

3   from the group consisting of:

4   the number of occurrences of the item in a user log;

5   the logarithm of the number of occurrences of the item in a user

6   log;

7   the number of occurrences of the item in all user logs;

8   the logarithm of the total number of users divided by the number

9   of users who have selected the item; and

10   a normalizing factor.

1   31. The computer-implemented method of claim 30, wherein the normal-

2   izing factor is $\dfrac{1}{\sqrt{\sum (S_j W_{ij})^2}}$, where S_j is a weight based on the number of occur-

3   rences of the item in all user logs and W_{ij} is a weight based on the number of oc-

4   currences of the item in a particular user log.

1   32. The computer-implemented method of claim 1, further comprising:

2   deleting from the determined at least one result item any result items al-

3   ready selected by a user associated with the query.

1   33. The computer-implemented method of claim 1, further comprising:

2   ranking the at least one result item responsive to the degree of signifi-

3   cance.

1   34. A computer-implemented method of discovering a relationship be-

2   tween a first item and a second item, comprising:

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3   determining a total number of item groups N;

4   determining a number of item groups N_1 in a subset of item groups, the

5   subset of item groups being defined as including those item

6   groups that contain a second item;

7   determining a number of item groups N_2 not in the subset of item groups;

8   determining a number of item groups k_{11} in the subset that contain the

9   first item;

10   determining a number of item groups k_{12} not in the subset that contain the

11   first item;

12   determining a number of item groups $k_{21} = N_1 - k_{11}$ in the subset that do

13   not contain the first item;

14   determining a number of item groups $k_{22} = N_2 - k_{12}$ not in the subset that

15   do not contain the first item;

16   and determining a log likelihood ratio.

1   35. The computer-implemented method of claim 34, wherein the log like-

2   lihood ratio is defined as:

3      $$\sum k_{ij} \log \frac{\pi_{ij}}{\mu_j}$$

4   where: $\pi_{ij} = \frac{k_{ij}}{N_j}, \mu_j = \sum_i \frac{k_{ij}}{N}.$

1   36. The computer-implemented method of claim 35, wherein each item

2   group comprises a document.

1   37. The computer-implemented method of claim 35, further comprising:

2   adjusting at least one of the k_{ij} values responsive to at least one selected

3   from the group consisting of:

4   the number of occurrences of the item in a document;

5   the logarithm of the number of occurrences of the item in a docu-

6   ment;

7   the number of occurrences of the item in all documents;

8   the logarithm of the total number of documents divided by the

9   number of documents that include the item; and

10   a normalizing factor.

1   38. The computer-implemented method of claim 37, wherein the normal-

2   izing factor is $\dfrac{1}{\sqrt{\sum (S_j W_{ij})^2}}$, where S_j represents the number of occurrences of

3   the item in all documents and W_{ij} represents the number of occurrences of the

4   item in a particular document.

1   39. A system for discovering relationships among items, comprising:

2   a user interface for accepting item selections from a plurality of users;

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3   at least one log database, coupled to the user interface, for storing a log for

4   each user, each log containing identifiers for the user's item

5   selections;

6   a query input device for accepting a query including at least one query

7   item identifier; and

8   a recommendation engine, coupled to the log database and to the query

9   input device, for scoring the user logs, responsive to a degree of

10   occurrence, to generate user log scores, and for determining at

11   least one result item, responsive to a degree of occurrence in at

12   least a subset of the scored user logs.

1   40. The system of claim 39, wherein the significance of the occurrence is

2   determined by a log likelihood ratio analysis and the recommendation engine

3   determines the at least one result item responsive to the determined significance.

1   41. The system of claim 39, wherein the significance of the occurrence is

2   determined by a substantial equivalent of a log likelihood ratio analysis and

3   wherein the recommendation engine determines the at least one result item re-

4   sponsive to the determined significance.

1   42. The system of claim 39, wherein each item is a video track and wherein

2   the user interface accepts item selections by determining which tracks are se-

3   lected for playback.

1   43. The system of claim 39, wherein the user interface accepts item selec-

2   tions by determining which tracks are selected for purchase.

1   44. The system of claim 39, wherein each item is a music track and

2   wherein the user interface accepts item selections by determining which tracks

3   are selected for playback.

1   45. The system of claim 44, wherein the user interface comprises an online

2   jukebox.

1   46. The system of claim 45, wherein the online jukebox monitors user be-

2   havior with respect to the selected items and adjusts the user log scores respon-

3   sive to the monitored user behavior.

1   47. The system of claim 46, wherein the online jukebox monitors user be-

2   havior by detecting at least one selected from the group consisting of:

3   user input requesting that a selected item be repeated; and

4   user input requesting that a selected item be skipped; and

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5   user input specifying a volume change; and

6   user input specifying that a selected item be muted.

1   48. The system of claim 47, further comprising:

2   a track list generator, coupled to the recommendation engine, for generat-

3   ing a track list containing an identifier for each determined re-

4   sult item comprising a music track.

1   49. The system of claim 44, further comprising:

2   a music player, coupled to the track list generator, for playing the music

3   tracks specified by the generated track list.

1   50. The system of claim 44, further comprising:

2   a format scheduler, for accepting a format schedule specifying music track

3   categories for time periods; and

4   a track list generator, coupled to the recommendation engine and to the

5   format scheduler, for generating a track list conforming to the

6   format schedule and containing an identifier for each deter-

7   mined result item comprising a music track.

1   51. The system of claim 39, wherein the query input device receives a user

2   log containing identifiers for a user's item selections.

1   52. The system of claim 39, wherein the query input device receives a first

2   search term, the system further comprising:

3   a search term generator, coupled to the recommendation engine, for gen-

4   erating a second search term containing an identifier for each

5   determined result item and for providing the second search

6   term as input for a search engine.

1   53. The system of claim 39, wherein the query input device receives a first

2   search term, the system further comprising:

3   a search term generator, coupled to the recommendation engine, for gen-

4   erating a second search term containing an identifier for each

5   determined result item and for providing the second search

6   term to be added to a searchable portion of a document associ-

7   ated with the first search term.

1   54. The system of claim 39, further comprising:

2   an advertisement output device, coupled to the recommendation engine,

3   for outputting an advertisement relating to the determined at

4   least one result item.

1   55. The system of claim 54, wherein the advertisement output device dis-

2   plays at least one selected from the group consisting of:

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3   a web page;

4   a banner;

5   a portion of a web page; and

6   an animation.

1   56. The system of claim 39, further comprising:

2   a notification output, coupled to the recommendation engine, for output-

3   ting a notification relating to the determined at least one result

4   item.

1   57. The system of claim 56, wherein the notification output device displays

2   at least one selected from the group consisting of:

3   a web page;

4   a banner;

5   a portion of a web page; and

6   an animation.

1   58. The system of claim 56, wherein the notification output device sends a

2   communication to a user.

1   59. A computer-readable medium comprising computer-readable code for

2   discovering relationships between items, comprising:

3   computer-readable code adapted to accept item selections from a plurality

4   of users;

5   computer-readable code adapted to generate a log for each user, each log

6   containing identifiers for the user's item selections;

7   computer-readable code adapted to accept a query including at least one

8   query item identifier;

9   computer-readable code adapted to score the user logs, responsive to a

10   degree of occurrence of the at least one query item identifier in

11   the user logs, to generate user log scores; and

12   computer-readable code adapted to determine at least one result item, re-

13   sponsive to a degree of occurrence in at least a subset of the

14   scored user logs.

1   60. The computer-readable medium of claim 59, wherein a significance of

2   the occurrence is determined by a log likelihood ratio analysis and the deter-

3   mined result is responsive to the determined significance.

1   61. The computer-readable medium of claim 59, wherein a significance of

2   the occurrence is determined by a substantial equivalent of a log likelihood ratio

3   analysis and the determined result is responsive to the determined significance.

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1   62. The computer-readable medium of claim 59, wherein each item is a

2   video track and wherein the computer-readable code adapted to accept item se-

3   lections comprises computer-readable code adapted to determine which tracks

4   are selected for playback.

1   63. The computer-readable medium of claim 59, wherein each item is a

2   music track and wherein the computer-readable code adapted to accept item se-

3   lections comprises computer-readable code adapted to determine which tracks

4   are selected for playback.

1   64. The computer-readable medium of claim 63, further comprising:

2   computer-readable code adapted to generate a track list containing an

3   identifier for each determined result item comprising a music

4   track.

1   65. The computer-readable medium of claim 64, further comprising:

2   computer-readable code adapted to delete from the track list at least one

3   identifier corresponding to a music track already selected by the

4   user.

1   66. The computer-readable medium of claim 64, further comprising:

2   computer-readable code adapted to play the music tracks specified by the

3   generated track list.

1   67. The computer-readable medium of claim 63, further comprising:

2   computer-readable code adapted to accept a format schedule specifying

3   music track categories for time periods; and

4   computer-readable code adapted to generate a track list conforming to the

5   format schedule and containing an identifier for each deter-

6   mined result item comprising a music track.

1   68. The computer-readable medium of claim 63, wherein the computer-

2   readable code adapted to score the user logs comprises computer-readable code

3   adapted to determine a degree of occurrence in each user log of at least one mu-

4   sic track identified by the query item identifier.

1   69. The computer-readable medium of claim 63, wherein the computer-

2   readable code adapted to score the user logs comprises computer-readable code

3   adapted to determine a degree of occurrence in each user log of at least one mu-

4   sic track associated with an artist identified by the query item identifier.

1   70. The computer-readable medium of claim 59, wherein the computer-

2   readable code adapted to accept item selections comprises computer-readable

3   code adapted to receive input provided by a user via a web page.

1   71. The computer-readable medium of claim 59, wherein the computer-

2   readable code adapted to accept item selections comprises computer-readable

3   code adapted to receive input specifying an item purchase by a user.

1   72. The computer-readable medium of claim 59, further comprising, com-

2   puter-readable code adapted to, prior to determine the at least one result item,

3   define the subset of the scored user logs responsive to the user log scores.

1   73. The computer-readable medium of claim 59, further comprising:

2   computer-readable code adapted to monitor user behavior with respect to

3   the selected items; and

4   computer-readable code adapted to adjust the user log scores responsive

5   to the monitored user behavior.

1   74. The computer-readable medium of claim 73, wherein the computer-

2   readable code adapted to monitor user behavior comprises at least one selected

3   from the group consisting of:

4   computer-readable code adapted to detect user input requesting that a se-

5   lected item be repeated;

6   computer-readable code adapted to detect user input requesting that a se-

7   lected item be skipped;

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8   computer-readable code adapted to detect user input specifying a volume

9   change; and

10   computer-readable code adapted to detect user input specifying that a se-

11   lected item be muted.

1   75. The computer-readable medium of claim 59, wherein the computer-

2   readable code adapted to accept item selections comprises computer-readable

3   code adapted to receive input provided by a user via an application for playing

4   tracks.

1   76. The computer-readable medium of claim 59, wherein the computer-

2   readable code adapted to accept a query comprises computer-readable code

3   adapted to receive a user log containing identifiers for a user's item selections.

1   77. The computer-readable medium of claim 59, wherein the computer-

2   readable code adapted to accept a query comprises computer-readable code

3   adapted to receive a first search term, the computer-readable medium further

4   comprising:

5   computer-readable code adapted to generate a second search term con-

6   taining an identifier for each determined result item.

1   78. The computer-readable medium of claim 77, further comprising at

2   least one of:

3   computer-readable code adapted to provide the second search term as in-

4   put for a search engine; and

5   computer-readable code adapted to add the second search term to a

6   searchable portion of a document associated with the first

7   search term.

1   79. The computer-readable medium of claim 59, further comprising:

2   computer-readable code adapted to periodically upload the generated log.

1   80. The computer-readable medium of claim 59, further comprising:

2   computer-readable code adapted to output an advertisement relating to

3   the determined at least one result item.

1   81. The computer-readable medium of claim 80, wherein the computer-

2   readable code adapted to output an advertisement comprises computer-readable

3   code adapted to display at least one selected from the group consisting of:

4   a web page;

5   a banner;

6   a portion of a web page; and

7   an animation.

1   82. The computer-readable medium of claim 59, further comprising:

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2   computer-readable code adapted to output a notification relating to the

3   determined at least one result item.

1   83. The computer-readable medium of claim 82, wherein the computer-

2   readable code adapted to output a notification comprises computer-readable

3   code adapted to display a web page.

1   84. The computer-readable medium of claim 82, wherein the computer-

2   readable code adapted to output a notification comprises computer-readable

3   code adapted to send a communication to a user.

1   85. The computer-readable medium of claim 84, wherein the computer-

2   readable code adapted to send a communication to a user comprises at least one

3   selected from the group consisting of:

4   computer-readable code adapted to transmit an electronic mail message to

5   the user;

6   computer-readable code adapted to telephone the user; and

7   computer-readable code adapted to send a direct mail item to the user.

1   86. The computer-readable medium of claim 59, wherein the determined

2   result is responsive to a significance of the occurrence of the item in at least a

3   subset of the scored user logs, and wherein the computer-readable code adapted

4   to determine a binomial log likelihood ratio for an item comprises computer-

5   readable code adapted to determine the result by a log likelihood ratio analysis

6   submethod.

1   87. The computer-readable medium of claim 86, wherein the computer-

2   readable code adapted to determine the result by a log likelihood ratio analysis

3   submethod comprises:

4   computer-readable code adapted to determine a total number of users N;

5   computer-readable code adapted to determine a number of users N_1 in a

6   subset of users;

7   computer-readable code adapted to determine a number of users N_2 not in

8   the subset of users;

9   computer-readable code adapted to determine a number of users k_{11} in the

10   subset that selected the item;

11   computer-readable code adapted to determine a number of users k_{12} not

12   in the subset that selected the item;

13   computer-readable code adapted to determine a number of users $k_{21} = N_1$

14   - k_{11} in the subset that did not select the item;

15   computer-readable code adapted to determine a number of users $k_{22} = N_2$

16   - k_{12} not in the subset that did not select the item; and

17   computer-readable code adapted to determine a log likelihood ratio for

18   the item.

1   88. The computer-readable medium of claim 87, wherein the log likeli-

2   hood ratio is defined as:

3    $$\sum k_{ij} \log \frac{\pi_{ij}}{\mu_j}$$

4   where: $\pi_{ij} = \dfrac{k_{ij}}{N_j}, \mu_j = \sum_i \dfrac{k_{ij}}{N}$.

1   89. The computer-readable medium of claim 59, wherein the computer-

2   readable code adapted to determine the result by a log likelihood ratio analysis

3   submethod further comprises:

4   computer-readable code adapted to adjust at least one of the n_{ij} values re-

5   sponsive to at least one selected from the group consisting of:

6   the number of occurrences of the item in a user log;

7   the logarithm of the number of occurrences of the item in a user

8   log;

9   the number of occurrences of the item in all user logs;

10   the logarithm of the total number of users divided by the number

11   of users who have selected the item; and

12   a normalizing factor.

1 90. The computer-readable medium of claim 89, wherein the normalizing

2 factor is $\dfrac{1}{\sqrt{\sum (S_j W_{ij})^2}}$, where S_j is a weight based on the number of occurrences

3 of the item in all user logs and W_{ij} is a weight based on the number of occur-

4 rences of the item in a particular user log.

1 91. The computer-readable medium of claim 59, further comprising:

2 computer-readable code adapted to delete from the determined at least

3 one result item any result items already selected by a user asso-

4 ciated with the query.

1 92. The computer-readable medium of claim 59, further comprising:

2 computer-readable code adapted to rank the at least one result item re-

3 sponsive to the degree of significance.

1 93. A computer-readable medium comprising computer-readable code for

2 discovering a relationship between a first item and a second item, comprising:

3 computer-readable code adapted to determine a total number of item

4 groups N;

5 computer-readable code adapted to determine a number of item groups

6 N_1 in a subset of item groups, the subset of item groups being

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7   defined as including those item groups that contain a second

8   item;

9   computer-readable code adapted to determine a number of item groups

10   N_2 not in the subset of item groups;

11   computer-readable code adapted to determine a number of item groups

12   k_{11} in the subset that contain the first item;

13   computer-readable code adapted to determine a number of item groups

14   k_{12} not in the subset that contain the first item;

15   computer-readable code adapted to determine a number of item groups

16    $k_{21} = N_1 - k_{11}$ in the subset that do not contain the first item;

17   computer-readable code adapted to determine a number of item groups

18    $k_{22} = N_2 - k_{12}$ not in the subset that do not contain the first item;

19   and

20   computer-readable code adapted to determine a log likelihood ratio.

1   94. The computer-readable medium of claim 93, wherein the log likeli-

2   hood ratio is defined as:

3    $$\sum k_{ij} \log \frac{\pi_{ij}}{\mu_j}$$

4   where: $\pi_{ij} = \frac{k_{ij}}{N_j}, \mu_j = \sum_i \frac{k_{ij}}{N}.$

1　　95. The computer-readable medium of claim 93, wherein each item group

2　comprises a document.

1　　96. The computer-readable medium of claim 93, further comprising:

2　computer-readable code adapted to adjust at least one of the k_{ij} values re-

3　　　　sponsive to at least one selected from the group consisting of:

4　　　　the number of occurrences of the item in a document;

5　　　　the logarithm of the number of occurrences of the item in a docu-

6　　　　　　ment;

7　　　　the number of occurrences of the item in all documents;

8　　　　the logarithm of the total number of documents divided by the

9　　　　　　number of documents that include the item; and

10　　　a normalizing factor.

1　　97. The computer-readable medium of claim 96, wherein the normalizing

2　factor is $\dfrac{1}{\sqrt{\sum (S_j W_{ij})^2}}$, where S_j represents the number of occurrences of the item

3　in all documents and W_{ij} represents the number of occurrences of the item in a

4　particular document.